August 2018 ABC-UTC Webinar Featured Presentation: Use of SPMTs, Barges, and Strand Jacks to Build the Hastings, MN Bridge		
#	**Questions**	**Responses**
	Design	
1	How was lateral stability of the arch ribs checked?	Through a 3D FEM analysis utilizing a step-by-step load increment approach for second-order incremental buckling to obtain the moment magnification factors and generate the first-order modes. The applied loads are then increased incrementally until the arch rib reaches the stability limit. A FS for stability of 3.25 was achived in the final design.
2	How were tolerable distortions and deflections calculated?	Stability and stress were evaluated against temporary and final material costs to develop acceptable deflections for both constructability and final service. Further, MnDOT specified additional criteria for this alternative including a minimum Factor of Safety against arch bucking of 2.0 at the Strength Limit state, and a limiting lateral deflection of R/300.
3	Can you comment on the connection detail forces that the connection is designed to transmit during fabrication, erection, and final state?	With regard to the steel temporary knuckle connection, its primary use was for erection. After erection it was embedded into the final concrete knuckle connection in the permanent work. There were no fabrication forces in any of the connections to account for.
4	Corrosion and dead load would be key design issues. Were composite materials utilized in this bridge design? If so, how and where?	No composite materials were used in the design of the bridge. The structural steel consists of weathering steel, and the reinforcing in the superstructure is stainless steel for durability. All concrete was modeled for 100-year service life using material modeling software.
5	Would like to see photos and drawings of the final connection securing the tied arch atop the permanent piers after completing the lift.	Please see our paper titled "INNOVATIVE STEEL ARCHES OVER THE MISSISSIPPI UTILIZING ABC TECHNOLOGY" for AISC, Feb. 2014.
	Construction	

6	Elaborate on the lateral jacking system (details, forces jacked out, etc.).	The bridge was jacked against the main river pier for displacement of about 2 inches to account for PT shortening and long-term creep and shrinkage at a force of 700 kips.
7	What were the maximum loads in the strand jacks during the lift?	The load was consistent from lift off from on land to complete erection on the water at 3,565 Tons.
8	How were the strand jacks anchored to the piers?	The arch reaction force was supported by four 2 ½ inch-diameter post-tensioning bars cast into the top of the pier.
9	How sensitive was the stressing/destressing to handle changing support points between the construct, transport, and final stages?	After load was transferred from the shoring towers to the SPMT's on land there were no significant changes in support locations, and no "stressing" was required other than the natural tied arch loading into the temporary tie system.
10	Why was the float-in used instead of assemble-in-place?	With a focus on accelerated bridge construction techniques, the team determined very early that the traditional methods of "stick building" the arch in place did not meet the project schedule and presented significant schedule risks due to the river constraints and river closure window restriction for navigational traffic.
11	What were the biggest challenges when moving the structure from land to the barges?	Maintaining a transversely out-of-plumb by a maximum of 3.43% and to carry the 3,565-ton load down the 9-ft elevation drop 405 ft. from the staging yard surface to the barges while maintaining a 6-inch racking tolerance for between arch ends.
12	What is the most challenging part of construction?	Locking off the arch at the top of the piers after the lift.
13	What were the technical lessons learned?	Integration of the design team during construction is 100% necessary to achieve success and manage the natural changes that occur during the construction process.
	Cost	
14	What was the cost effectiveness of components of the arch handling?	Very cost effective for both the elements themselves and schedule. The solution chosen was unique to this team and the lowest cost best value winner of the project.

	Other	
15	Did you use a formal decision-making process such as AHP (Analytic Hierarchy Process) and PROMETHEE (Preference Ranking Organization METHod for Enrichment of Evaluations) in developing the project?	No, the contractor choose the superstructure type and construction method.
	Questions during Webinar	
16	Which method is better in cost-benefit? Is it mandatory to apply both SPMTs and barges?	A mix of system was the best value for our team to achive success.
17	Regarding the arch, what is the apex cross-section, and how did you plan for its inspection?	Access is provided at either end of the rib, and the proportions of the rib were selected to allow easy walk-through inspection from inside.
18	Why did you decide on a PT deck as opposed a more easily replaceable conventionally reinforced deck? With PT deck you have to close the entire bridge for repairs.	The deck is not PT'd nor is any of the concrete tie PT compression considered in the deck, making it fully replaceable at any point in its life. The concrete tie is designed for a 100-year life and is fully redundant for a 25% loss and remain 100% serviceable.
19	Why was a free standing arch used instead of connecting two arches for improved lateral resistance?	The steel free-standing arch ribs provided an easily maintained, aesthetically pleasing element. They also simplified fabrication since each arch can be assembled independently.
20	Is there an expansion joint between the arch and adjacent spans?	Yes, at each side of the arch.
21	Can you elaborate on how the arch was jacked, and temporary tie removed?	The force in the temporary tie was transferred into the permanent tie through sequencing the PT tie placement and deck placement until it was fully relieved and simply cut free.
22	What is the cost associated with not allowing fracture critical members? What was the cost increase?	This essentially doubles the cost of the steel deck framing system.
23	Why was the arch turned 180 degrees in the river on route from the assembly and erection site?	A correction: The bridge was actually only spun 90 degrees to align from its land position to the lifting positions at the pier.

24	If the arch was able to fit between the piers, how did you link the arch to the piers?	Large lifting lug were inserted into the back of the lifting connection to support the arch on the lifting frame free of the strand jack.
25	Is the arch section hollow? If yes, is it water tight?	It is hollow; it is sealed against water but not water tight.
26	Was seismic considered in the design?	No seismic considerations were required.
27	Were adjustments to the hangers required after the tie was post-tensioned?	No, no adjustments were required.
28	Comment on the temporary shoring design as the self-propelled modular transporters moved the arch to its permanent position.	Specialized trestles were constructed to handle the vertical and lateral load applied from the transporters. These were typical wharf style pile and strut braced systems.
29	Can you comment on the deep foundation design/construction work?	Primary foundations were 42-inch driven pipe piles to rock and fixed into the footing.
30	How much movement of the piers on each end of the arch has been witnessed?	About 2.5 inches.
31	Were precast slabs used for the deck, or was it CIP?	The deck was cast-in-place.